

Fig. 1

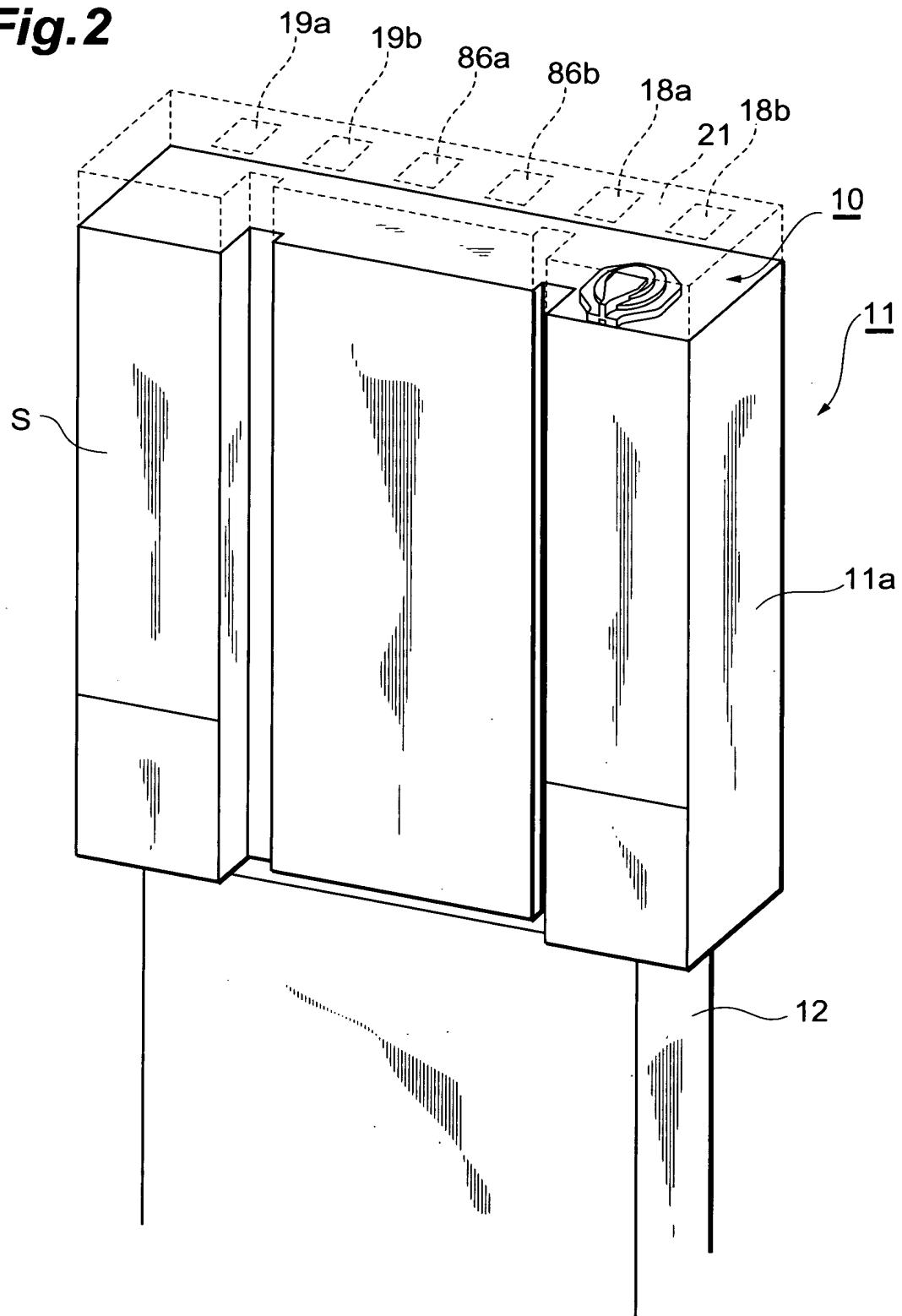
Fig.2

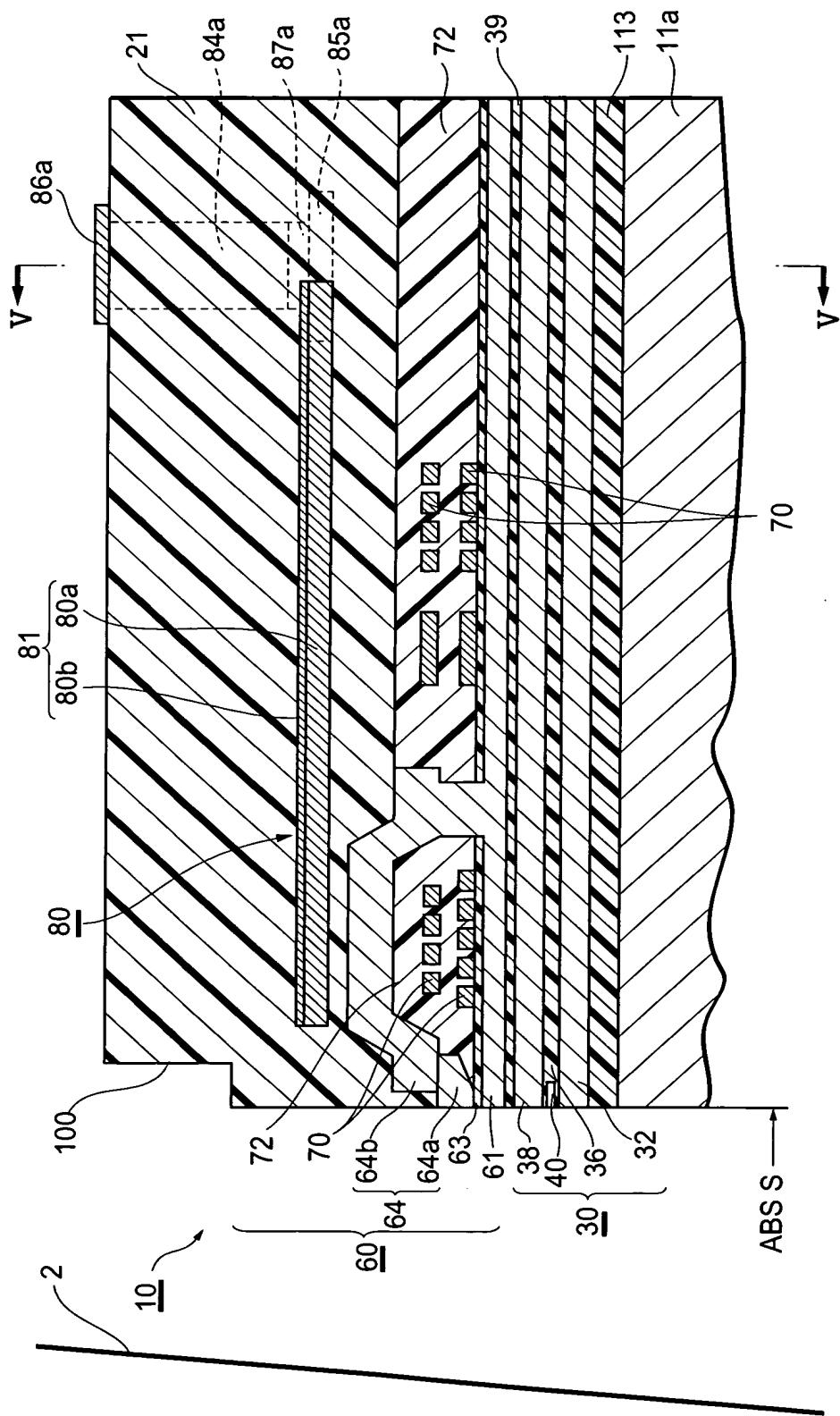
Fig. 3

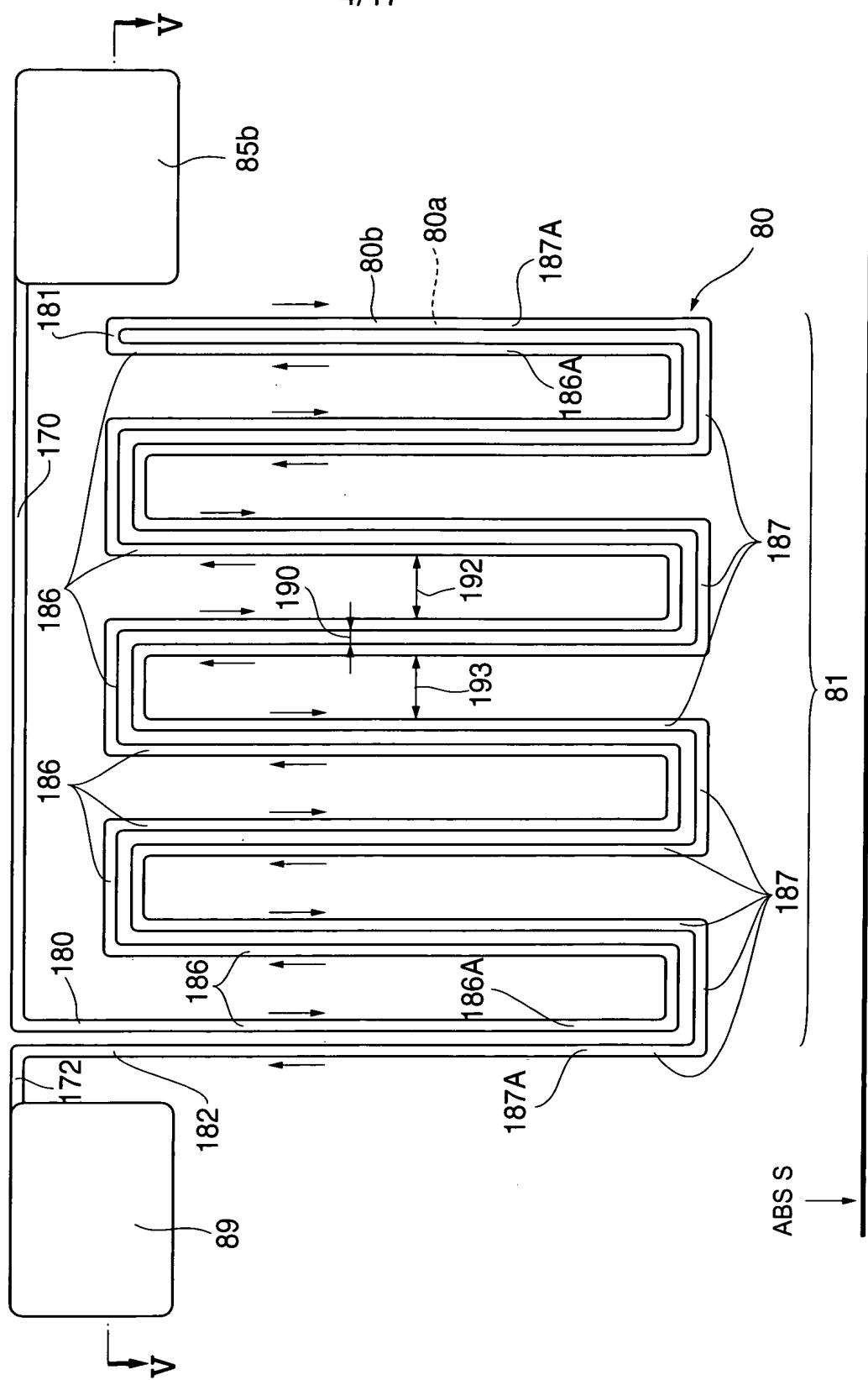
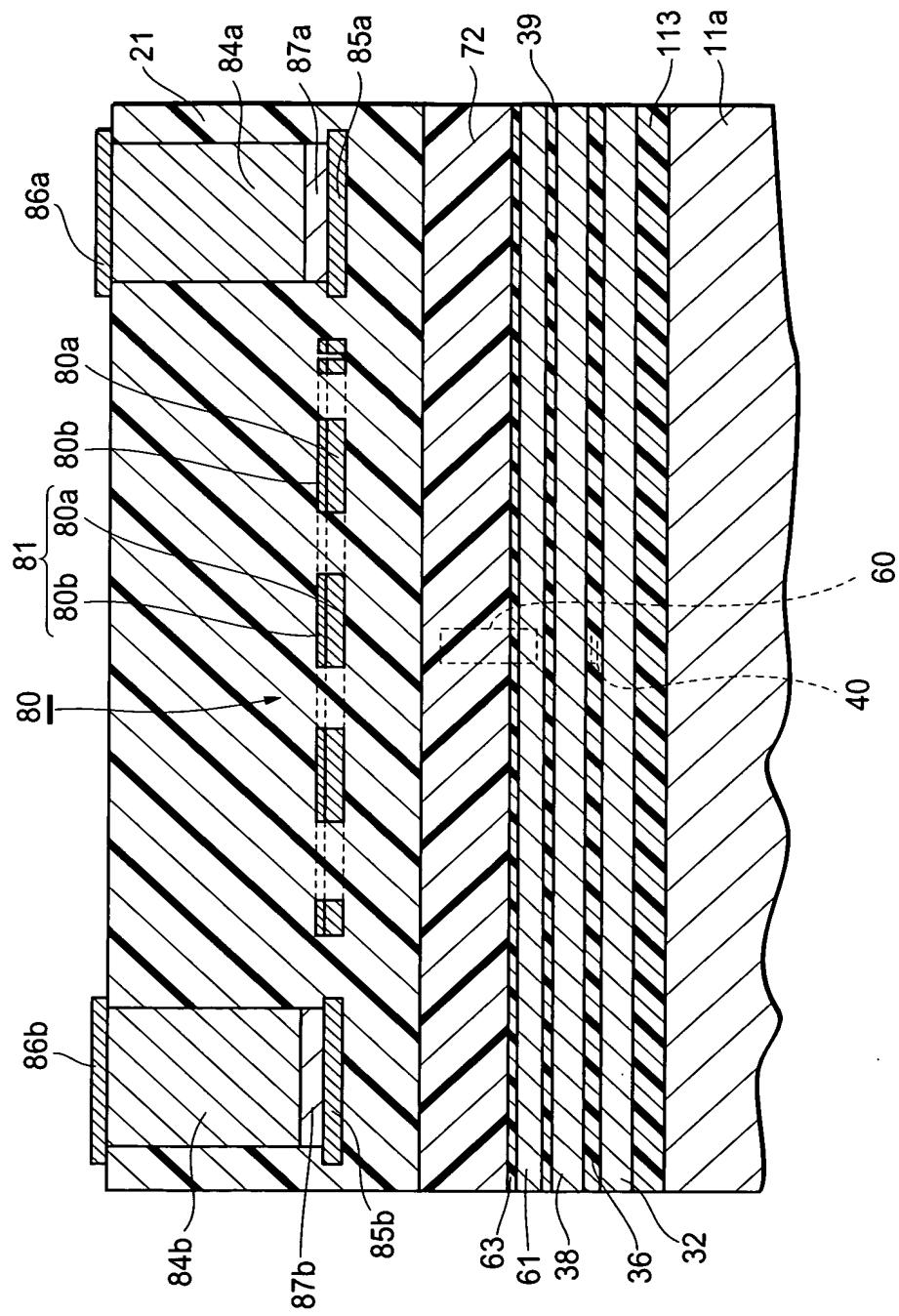
Fig.4

Fig. 5

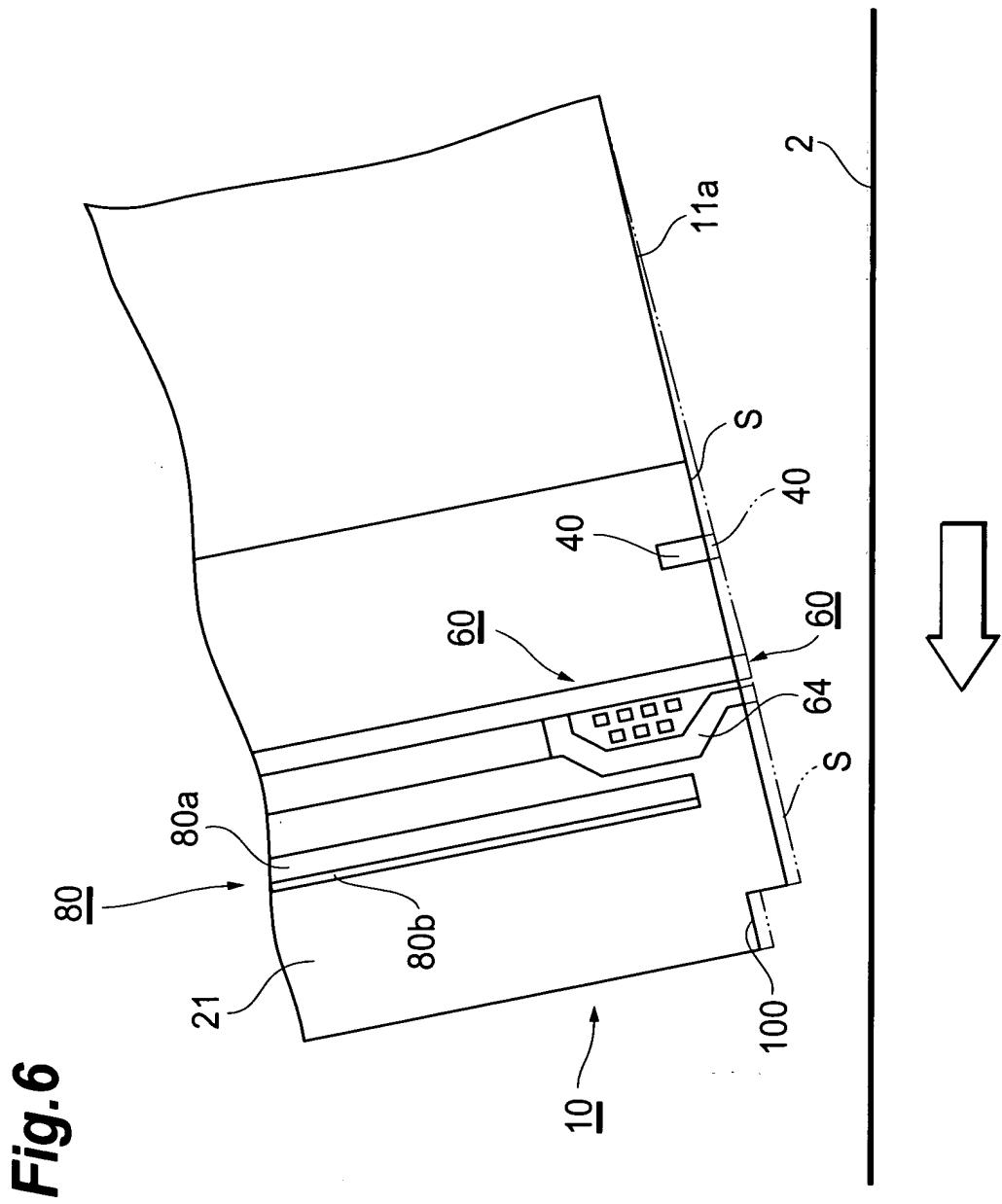
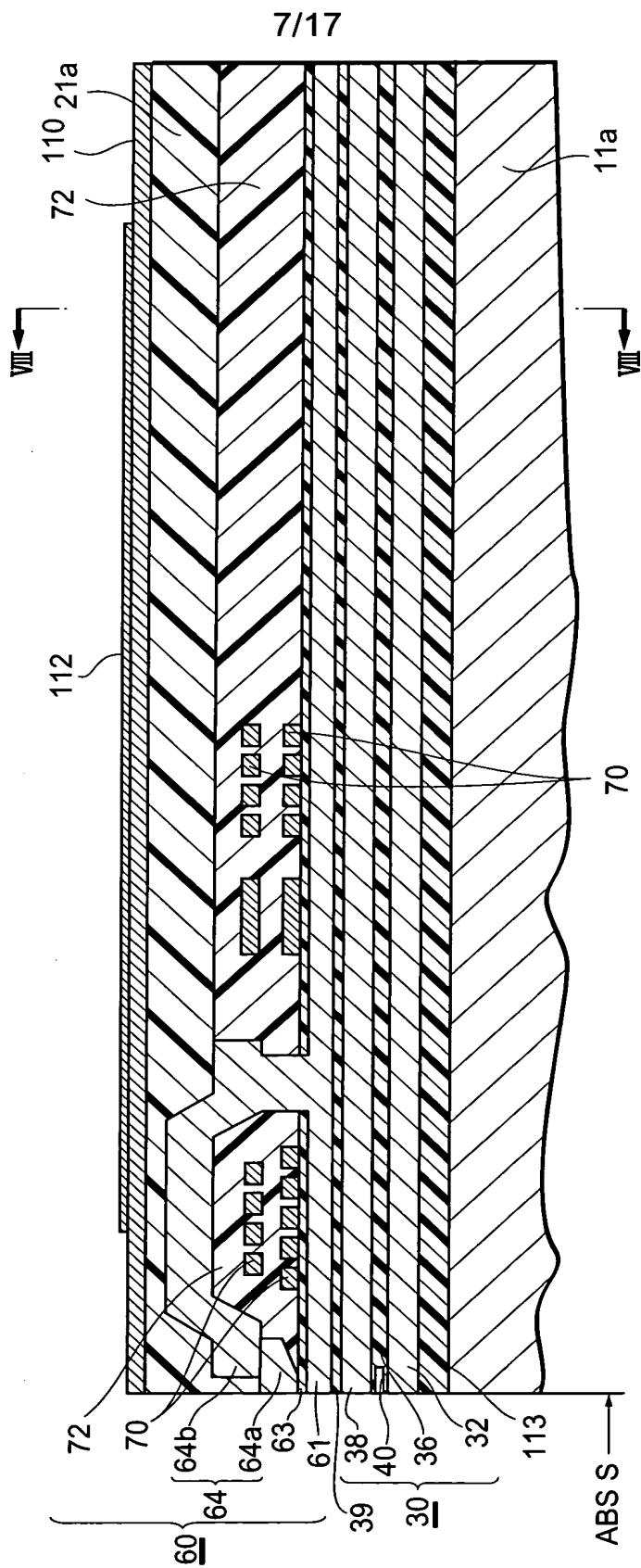


Fig. 7

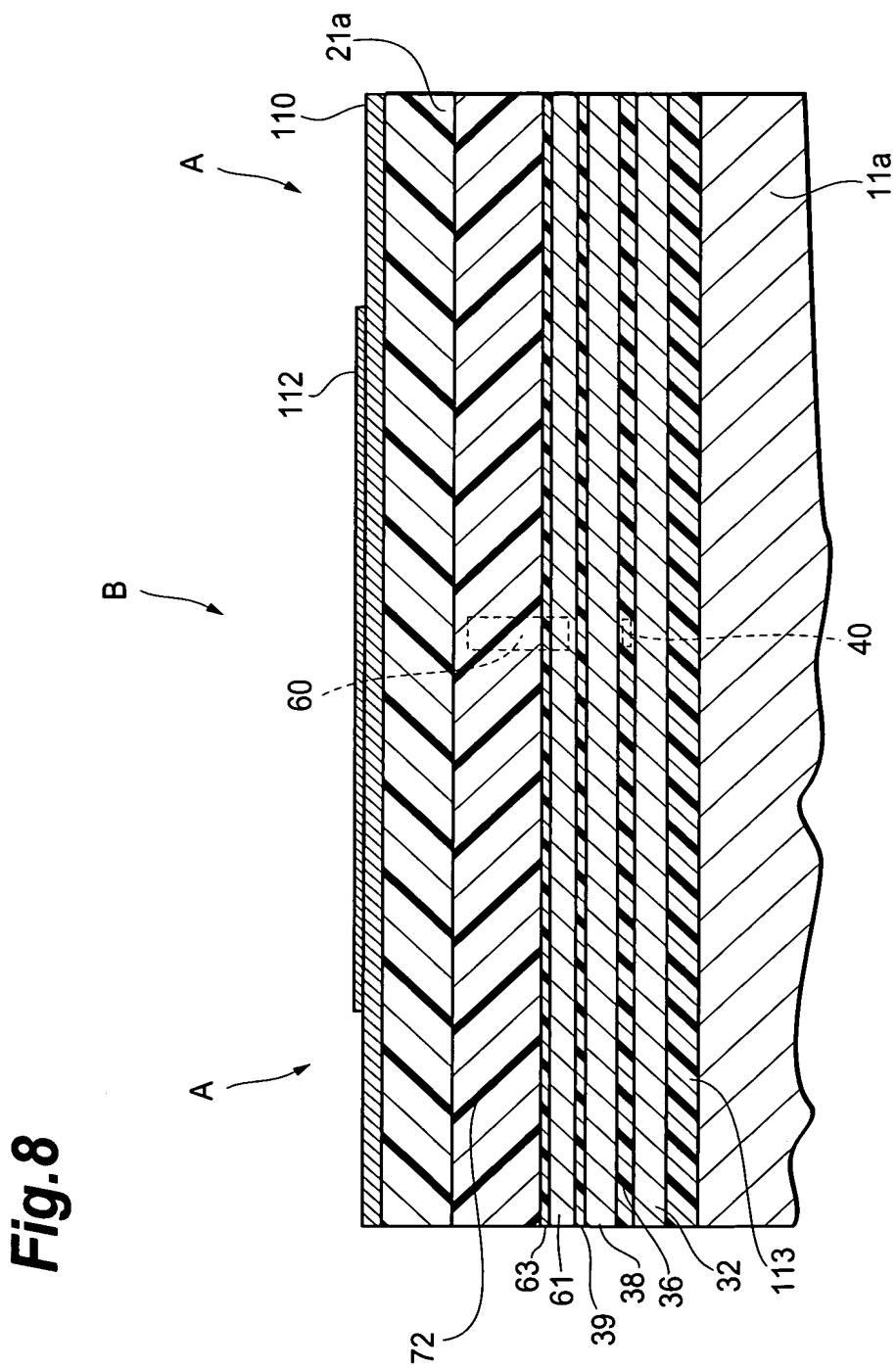


Fig. 8

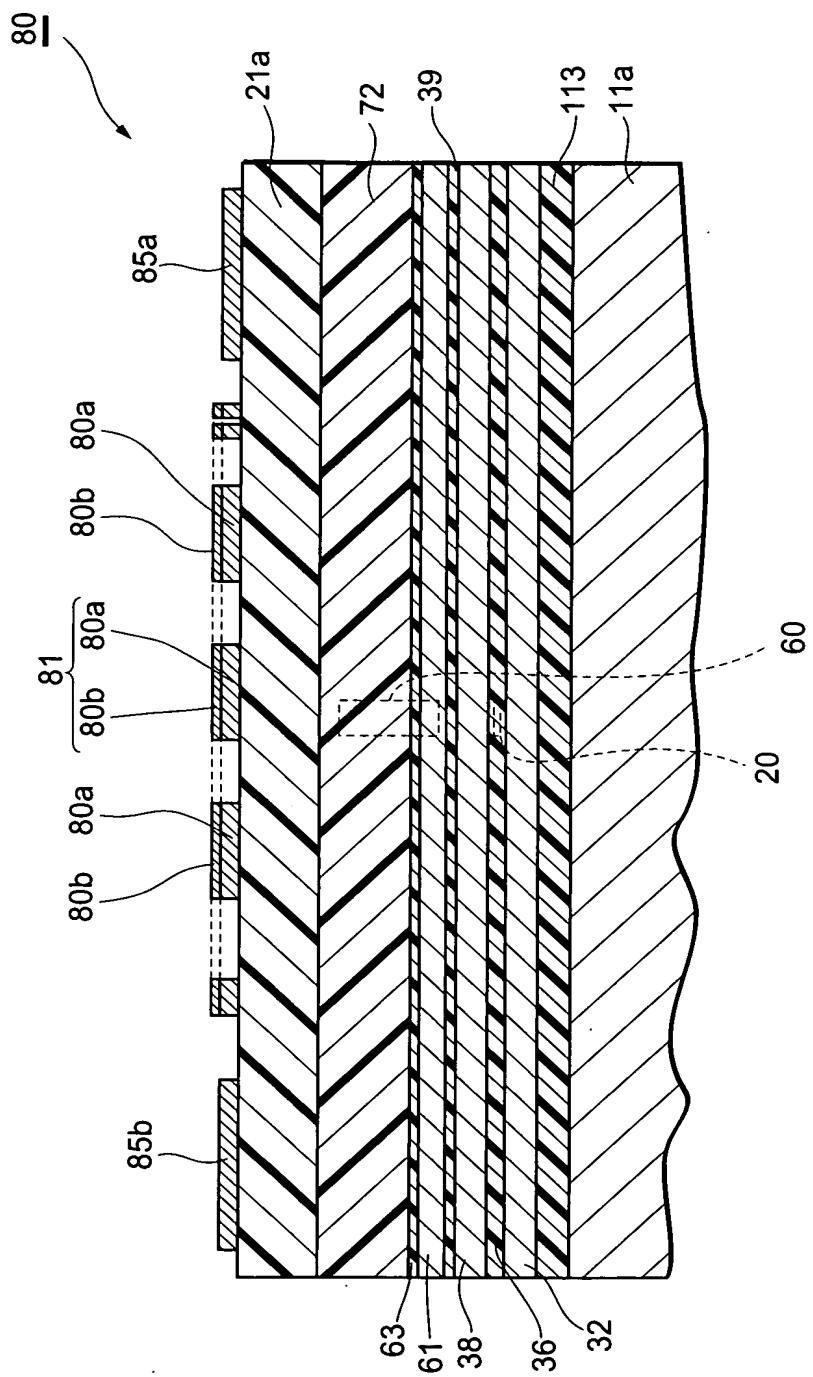
Fig.9

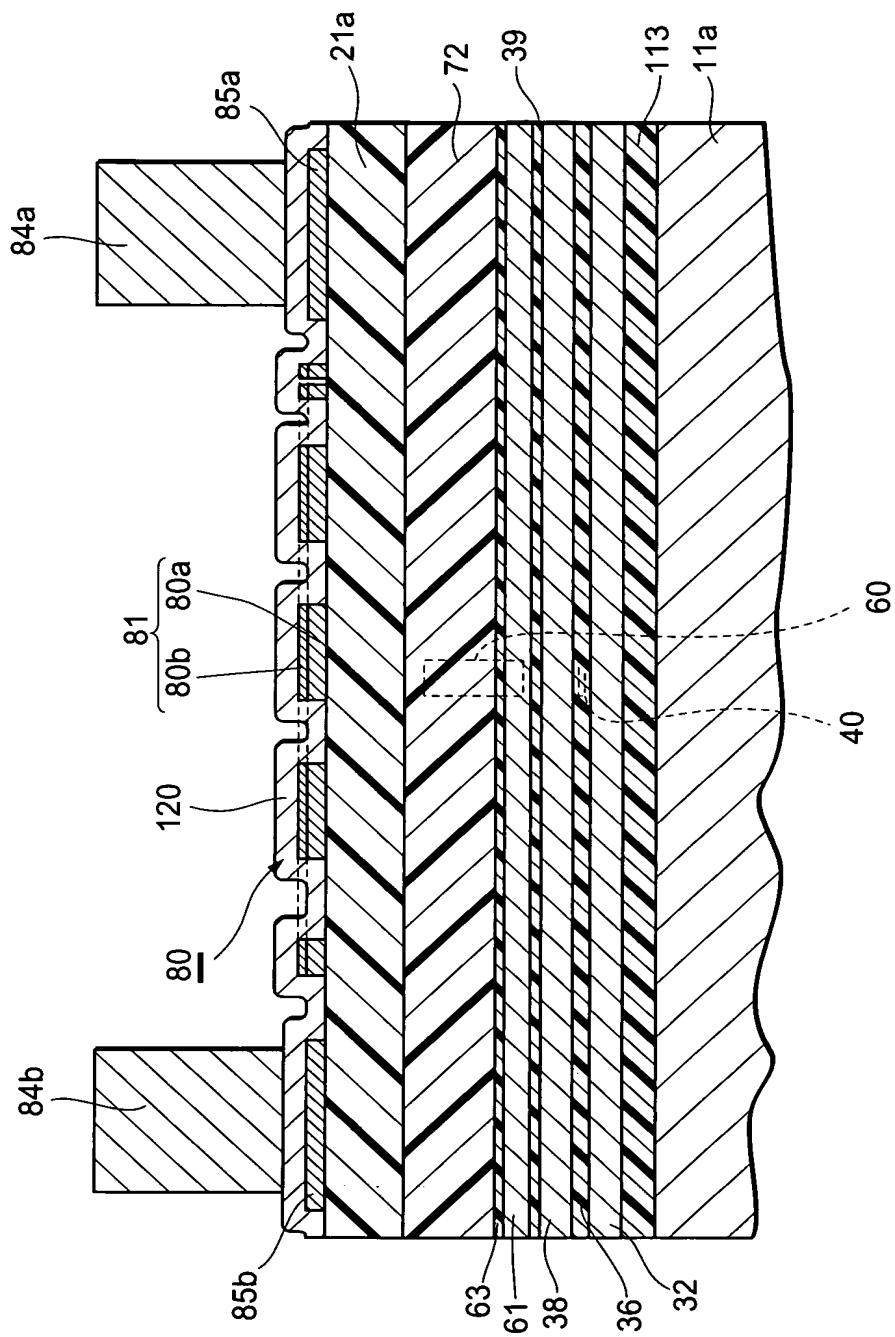
Fig. 10

Fig. 11

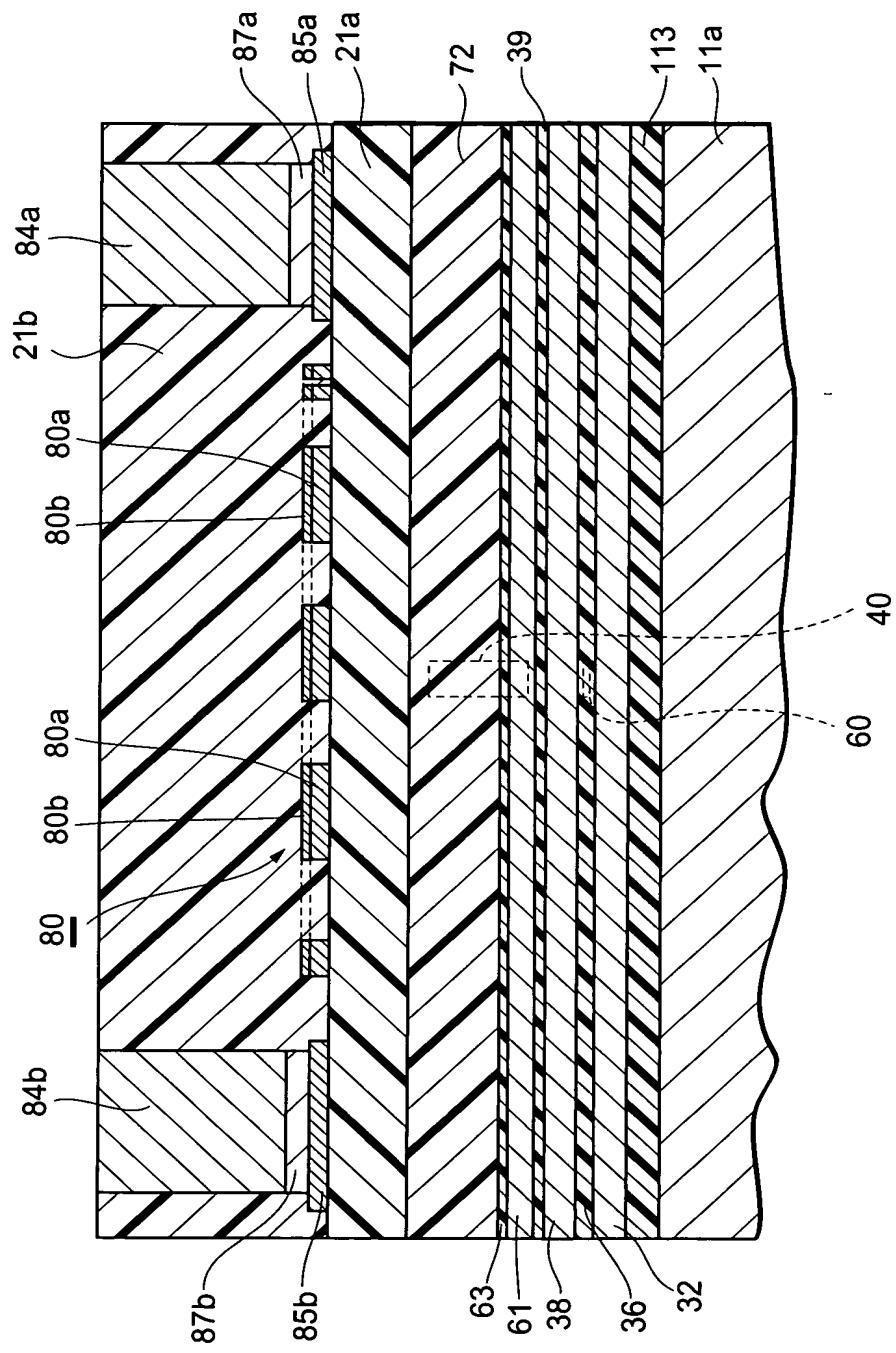


Fig. 12

	MATERIAL OF FIRST LAYER	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu \Omega \cdot \text{cm}$)	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu \Omega \cdot \text{cm}$)	RATIO OF RESISTIVITY OF MATERIAL OF SECOND LAYER TO RESISTIVITY OF MATERIAL OF FIRST LAYER (-)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	SHEET RESISTANCE OF HEATER (Ω)	SHEET RESISTANCE VARIATION (%)
COMPARATIVE EXAMPLE1	NiFe	23	—	—	—	150	—	1.533	7.2
EXAMPLE1	NiFe	23	NiFeNb (Nb5wt%)	45	2.0	150	20	1.643	—
EXAMPLE2	NiFe	23	NiFeNb (Nb10wt%)	70	3.0	150	10	1.436	3.3
EXAMPLE3	NiFe	23	NiFeNb (Nb14wt%)	90	3.9	150	20	1.483	—
EXAMPLE4	NiFe	23	NiFeNb (Nb20wt%)	120	5.2	150	20	1.469	2.1
EXAMPLE5	NiFe	23	Ti	180	7.8	150	20	1.508	0.8
EXAMPLE6	NiFe	23	Ta	180	7.8	150	10	1.508	0.8

Fig. 13

	MATERIAL OF FIRST LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu \Omega \cdot \text{cm}$)	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu \Omega \cdot \text{cm}$)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	RESISTANCE OF HEATER (Ω)	Sheet Resistance Variation (%)
COMPARATIVE EXAMPLE2	Cu	3	—	—	—	120	—	0.250
EXAMPLE7	Cu	3	AuCu (Cu5at%)	7.5	2.5	120	20	0.273
EXAMPLE8	Cu	3	AuNi (Ni5at%)	10.5	3.5	120	10	0.231
EXAMPLE9	Cu	3	AuNi (Ni7at%)	12	4.0	120	10	0.240
EXAMPLE10	Cu	3	AuNi (Ni10at%)	15	5.0	120	20	0.238
EXAMPLE11	Cu	3	NiFe	23	7.7	120	10	0.244
EXAMPLE12	Cu	3	CoFe	20	6.7	120	20	0.242
						10	10	1.2

Fig. 14

	MATERIAL OF FIRST LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu \Omega \cdot \text{cm}$)	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu \Omega \cdot \text{cm}$)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	RESISTANCE OF HEATER (Ω)	SHEET RESISTANCE VARIATION (%)
COMPARATIVE EXAMPLE3	Au	3.5	—	—	—	120	—	0.292
EXAMPLE13	Au	3.5	AuCu (Cu5at%)	7.5	2.1	120	20	0.318
EXAMPLE14	Au	3.5	AuCu (Ni10at%)	10	2.9	120	10	0.266
EXAMPLE15	Au	3.5	AuCu (Ni20at%)	14	4.0	120	20	0.278
EXAMPLE16	Au	3.5	AuNi (Ni15at%)	20	5.7	120	10	0.276
EXAMPLE17	Au	3.5	Ti	180	51.0	120	10	0.283
EXAMPLE18	Au	3.5	Ta	180	51.0	120	20	0.281
							20	1.8
							20	0.286
							20	0.283
							10	0.287
							20	0.2907
							10	0.2912
							20	0.2907
							10	0.2912

Fig. 15

	MATERIAL OF FIRST LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu\Omega \cdot \text{cm}$)	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu\Omega \cdot \text{cm}$)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	SHEET RESISTANCE OF HEATER (Ω)	SHEET RESISTANCE VARIATION (%)
COMPARATIVE EXAMPLE4	Mo	16	—	—	150	—	1.067	7.1
EXAMPLE19	Mo	16	NiFeNb (Nb2wt%)	32	2.0	150	20	1.143
EXAMPLE20	Mo	16	NiFeNb (Nb5wt%)	45	2.8	150	10	1.000
EXAMPLE21	Mo	16	NiFeNb (Nb7wt%)	60	3.8	150	10	1.032
EXAMPLE22	Mo	16	NiFeNb (Nb12wt%)	80	5.0	150	20	1.018
EXAMPLE23	Mo	16	Ti	180	11.3	150	10	1.042
EXAMPLE24	Mo	16	Ta	180	11.3	150	10	1.060

Fig.16

	MATERIAL OF FIRST LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu \Omega \cdot \text{cm}$)	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu \Omega \cdot \text{cm}$)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	RESISTANCE OF HEATER (Ω)	Sheet Resistance Variation (%)
COMPARATIVE EXAMPLES	Rh	17.5	—	—	—	150	—	1.167
EXAMPLE25	Rh	17.5	NiFeNb (Nb2wt%)	32	1.8	150	20	1.250
EXAMPLE26	Rh	17.5	NiFeNb (Nb5wt%)	45	2.6	150	10	1.087
EXAMPLE27	Rh	17.5	NiFeNb (Nb10wt%)	70	4.0	150	10	1.126
EXAMPLE28	Rh	17.5	NiFeNb (Nb15wt%)	95	5.4	150	20	1.137
EXAMPLE29	Rh	17.5	Ti	180	10.3	150	10	1.148
EXAMPLE30	Rh	17.5	Ta	180	10.3	150	20	1.153
							20	1.152
							10	1.159
							20	1.152
							10	1.159

Fig. 17

	MATERIAL OF FIRST LAYER	RESISTIVITY OF MATERIAL OF FIRST LAYER ($\mu \Omega \cdot \text{cm}$)	MATERIAL OF SECOND LAYER	RESISTIVITY OF MATERIAL OF SECOND LAYER ($\mu \Omega \cdot \text{cm}$)	RATIO OF RESISTIVITY OF MATERIAL OF SECOND LAYER TO RESISTIVITY OF MATERIAL OF FIRST LAYER (-)	THICKNESS OF FIRST LAYER (nm)	THICKNESS OF SECOND LAYER (nm)	SHEET RESISTANCE OF HEATER (Ω)	SHEET RESISTANCE VARIATION (%)
COMPARATIVE EXAMPLE6	CoFe	20	-	-	-	130	-	1.538	8.4
EXAMPLE31	CoFe	20	NiFeNb (Nb5wt%)	45	2.3	130	20	1.667	
EXAMPLE32	CoFe	20	NiFeNb (Nb10wt%)	70	3.5	130	10	1.440	3.3
EXAMPLE33	CoFe	20	NiFeNb (Nb12wt%)	80	4.0	130	20	1.488	
EXAMPLE34	CoFe	20	NiFeNb (Nb15wt%)	95	4.8	130	10	1.474	2.1
EXAMPLE35	CoFe	20	Ti	180	9.0	130	20	1.505	
EXAMPLE36	CoFe	20	Ta	180	9.0	130	10	1.525	
								1.513	0.8
								1.513	0.8